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(54) PLATE HEAT EXCHANGER

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The Disclosure

The present invention relates to a heat exchanger comprising a plurality of plates stacked together to define between them sealed passages for two mutually heat exchanging fluids.

In conventional plate heat exchangers, all the heat exchange passages for at least one of the two fluids have identical flow conditions. This means that the flow rate and the pressure drop will be generally equal in these passages. This applies even to those passages which on only one side are enclosed by a heat exchanging plate, i.e., usually the outermost passages of the heat exchanger.

In comparison with the rest of the passages which on both sides are enclosed by heat exchanging plates, the flow rate and pressure drop in said outermost passages are equal while on the other hand the heat exchanging area is only half as large. For that reason, it is easily realized that the change of termperature in the outermost passages will be less than in the intermediate ones, since the heat transmission to or from the outer

passages is only about half of that of the other passages. This is disadvantageous for the following reasons.

Primarily, the above-mentioned conditions result in different heat treatment of different portions of a fluid. This may in turn have a negative effect on the quality of a product treated in a plate heat exchanger. Secondly, all the heat exchanging surfaces in the heat exchanger are not utilized as efficiently as possible, which is of economic importance, especially when expensive plate material is used. Thirdly, the temperature in some passages situated adjacent to the outer passages is also affected. This affection decreases successively with increasing distance from the outer passages, i.e., usually from the ends of the plate pack.

The principal object of the present invention is to eliminate the above-mentioned drawbacks of prior plate heat exchangers. This object is achieved by means of a plate heat exchanger of the kind first mentioned above and which is characterized by at least one passage which on only one of its sides is bounded by a heat exchanging plate and has a higher flow resistance than the rest of the passages for the same fluid.

With a heat exchanger according to the invention, it has been found possible to obtain generally equal change of temperature in all the passages for one and the same fluid, whereby the heat treatment of the fluid will be equal in all the passages. It is realized that the quality of a product treated in the heat exchanger can thereby be improved, and at the same time all heat exchanging surfaces can be efficiently utilized.

The invention will be described in more detail below with reference to the accompanying drawings in which Figs. 1 and 2 are schematic views of sections of conventional plate heat exchangers; Fig. 3 is a similar view of a corresponding section of

a heat exchanger according to the invention, and Figs. 4 and 5 are exploded perspective views, in diagrammatical form, of two embodiments of the heat exchanger according to the invention.

The conventional heat exchanger shown in Fig. 1 comprises seven plates 1-7 defining between them six heat exchange passages 9-14. A fluid A flows through three passages 10, 12, 14 and exchanges heat with a fluid B flowing through the other passages 9, 11, 13.

Of the three passages 10, 12, 14 for fluid A, the two first mentioned are enclosed on both sides by heat exchanging plates 2, 3 and 4, 5, respectively, while the passage 14 is bounded on only one side by a heat exchanging plate, which is shown at 6. Therefore, the change of temperature in the passage 14 is considerably less than in the passages 10 and 12, provided the flow rates in all three passages are equal. The conditions for fluid B are similar in that the passages 11 and 13 are enclosed by heat exchanging plates on both sides, while the passage 9 exchanges heat through only the plate 2.

The conventional heat exchanger illustrated in Fig. 2 corresponds to that in Fig. 1 with the exception that it is provided with an additional plate 8, whereby an additional heat exchange passage 15 is formed for fluid B. In this case, all the passages 10, 12, 14 for fluid A are enclosed by heat exchanging plates on both sides. In spite of this, the change of temperature in these passages will not be equal. Since the temperature in the one-sidedly heat exchanging outer passages 9 and 15 differs from that in passages 11 and 13 for the same fluid, the temperature in the adjacent passages 10 and 14 will also be influenced and will consequently differ from that prevailing in passage 12.

Fig. 3 illustrates a heat exchanger according to the invention which comprises eight plates 20 enclosing between them seven passages 21-27. The outer passages 21 and 27 are shown narrower than the intermediate ones in order to indicate that the flow resistance is higher in the outer passages, whereby the flow therein will be about half of that in the intermediate passages. Due to the fact that the flow rates in the outer passages 21 and 27 have thus been adapted to their heat exchanging areas, the change of temperature therein will be generally equal to that of the intermediate passages 23 and 25 for the same fluid B. In the passages 22, 24, 26 for the other fluid A, the change of temperature will also be mutually equal. A product treated in this heat exchanger will thus be subjected to the same heat treatment in all the passages.

It is indicated in Fig. 3 that the outer passages have been made narrower in order to reduce the flow therethrough. Other preferred means for achieving this effect are illustrated in Figs. 4 and 5.

The heat exchanger illustrated diagrammatically in Fig. 4 is assembled from two different kinds of plates 30 and 31, respectively, which are provided with corrugations in a so-called herringbone pattern. One such corrugation is indicated diagrammatically at 30a and 31a. The corrugations 30a of the plates 30 form a wider angle with the longitudinal axes of the plates than the corrugations 31a of the plates 31. It is presumed that the plates are equally spaced. As is well known by those skilled in the art, the wider angle provides for a higher flow resistance than the smaller angle. The two outermost passages on both sides are enclosed by plates 30 having a wide angle of corrugation, while the rest of the passages are enclosed on the one hand by a plate 30 and on the other hand by a plate 31

having a small angle of corrugation. The flow resistance is therefore higher in the outer passages than in the others, and consequently the flow rates are correspondingly smaller. Thus, in this way a desired reduction of the flow rates in the outer passages can be obtained, so that the change of temperature will be equal in all passages for the same fluid.

The plate combination illustrated in Fig. 5 is assembled from plates 30 and 31 of the same kind as those in Fig. 4. In this case, however, only two plates 30 having a wide angle of corrugation are used at the outermost positions. All the intermediate plates 31 have a smaller angle of corrugation. The two outermost passages are thus enclosed on the one hand by a plate 30 having a wide angle of corrugation and on the other hand by a plate 31 having a small angle of corrugation. These passages therefore present a higher flow resistance and a correspondingly smaller flow rate than the intermediate passages which are each enclosed by two plates having a small angle of corrugation.

The above-described embodiments should be considered as examples only, and it should be realized that other embodiments are possible within the scope of the following claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A heat exchanger comprising a plurality of parallel-oriented plates stacked together to define between adjacent plates a series of sealed passages for two heat-exchanging fluids, most of said passages being bounded on opposite sides thereof by plates which are heat-exchanging but at least one of said passages being bounded by a heat-exchanging plate on only one side of said one passage, said one passage having a higher flow resistance than the other passages for the same one of said two fluids.

2. The heat exchanger of claim 1, in which the flow resistance in said one passage provides a flow rate therethrough which is only about half as great as the flow rate through the other passages for the same fluid.

3. The heat exchanger of claim 1, in which each plate has a longitudinal axis and a herringbone corrugation having legs defining an angle with said axis, said angle being greater for the legs of the corrugations of the plates which bound said one passage than for the legs of the corrugations of at least one of the plates bounding each of said most passages.

4. The heat exchanger of claim 1, in which each plate has a longitudinal axis and a herringbone corrugation having legs defining an angle with said axis, said angle for the corrugation legs of the plates bounding said most passages being sharper than the angle for the corrugation legs of at least one of the two plates bounding said one passage.

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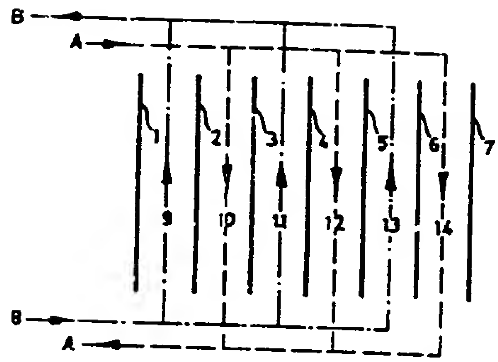

FIG. 1
PRIOR ART

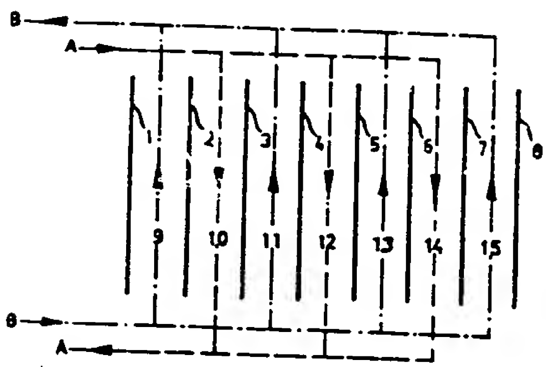

FIG. 2
PRIOR ART

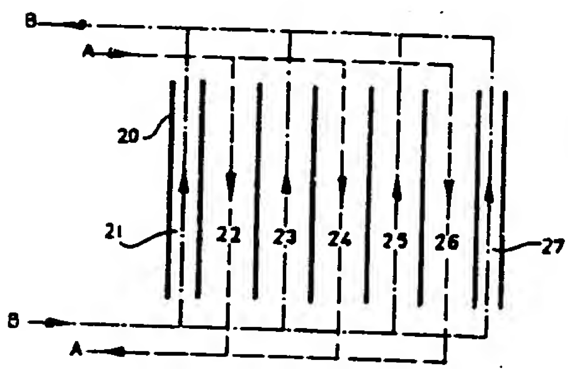

FIG. 3

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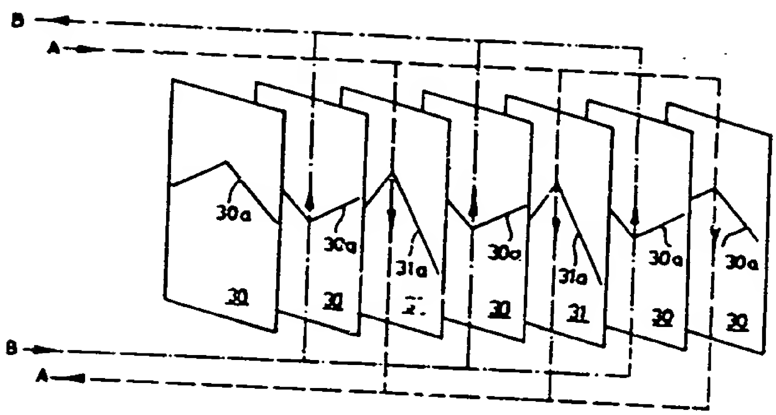

FIG. 4

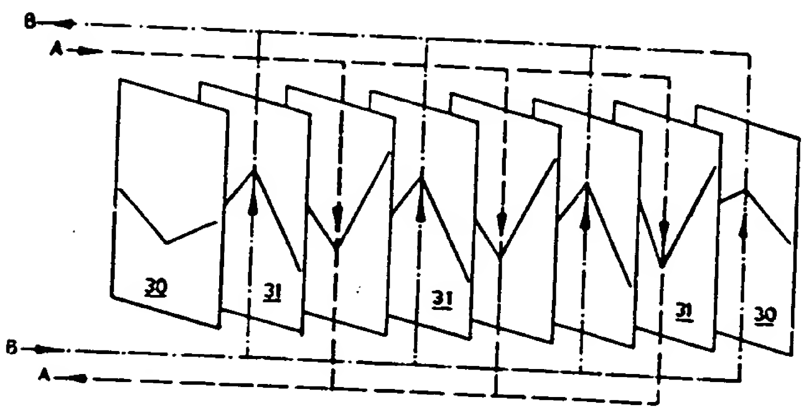

FIG. 5

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